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# Art. XII.—*Tektites from the Sherbrook River District, East of Port Campbell.*

By GEORGE BAKER, B.Sc.

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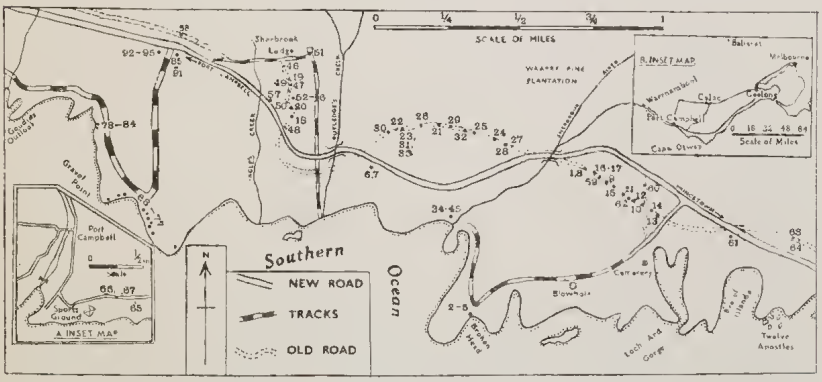
## Introduction.

In the district east and west of the mouth of the Sherbrook River near Port Campbell, 154 miles south-west of Melbourne, careful searching of patches and old roads free from vegetation led to the discovery of those varieties of tektites called australites. Eighty-three of these interesting objects were found.

The discoveries were made over an area 4 miles long and three-quarters of a mile wide, between Port Campbell Sports Ground (inset map A) and the Twelve Apostles. No forms were located west of Port Campbell.

The position where each form was found is indicated by a number on the accompanying map. Round forms were twice as abundant as elongate forms, and all the common shapes assumed by australites were represented.

It appears that this district is within the centre of one of the more congested australite areas.




Map 1.—Map of Sherbrook River area, showing location of australites.

## Mode of Occurrence.

The bedrock of the area consists of Tertiary limestones covered with a thin layer of clays and sands containing buckshot gravel.

Many of the australites rested loosely on the hard sandy soil of "borrow pits" which are bare patches from which material has been stripped by the Country Roads Board for surfacing the new road. Others rested on the compact earth forming the old road surface. Two forms, Nos. 18 and 20, rested on Tertiary limestone fragments used in repairing the old road, and one, No. 57, was found on the bank of the new road south-west of Sherbrook Lodge.

Of the total number of australites discovered, 58 had the anterior surface exposed, ten flange fragments and five complete forms had the posterior surface upwards, and the remainder (fragmentary) had fracture surfaces exposed to view.

Dr. Fenner (3, p. 60) has shown that the front or anterior surface of an australite is that surface showing flow-ridges. Since the majority of the forms, except flanges, occurred in the Port Campbell district with this surface upwards (reverse to flight position), each must have turned over after striking the earth, exposing the anterior surface, and thus indicating the more stable position of rest of these objects.

## Age.

Dr. Fenner (4, p. 140) believes that australites fell to the earth as one meteorite shower in prehistoric, but geologically recent times, and Beyer (1) states that Australian occurrences are the most recent tektites that have fallen on the earth.

Australites from Port Campbell are similar in form to those from other localities. They are fresher in appearance than the 556 forms in the Melbourne University collection, and show little or no signs of weathering, original surfaces having a somewhat duller lustre than the vitreous lustre of freshly fractured surfaces.

In this district, the old road was constructed in 1879, and the new road in 1933. Thirty-eight australites were found on the surface of the old road, and twenty on the surface of borrow-pits formed during the construction of the new road. Such occurrences point to the possibility of a fall of australites having occurred during man's occupation of the area. The general belief at present, however, is that all australites are prehistoric in age. If such be the case, those forms at Port Campbell which occur on recently prepared structures, should have fallen in prehistoric times, and it is difficult to explain their position if they fell prior to the making of roads and borrow-pits.

Dr. Fenner (3, p. 64) states that "the facts of the distribution in this area (i.e., Nullarbor Plains) strongly uphold the belief held by Australian investigators that, for the most part, the australites have been found in the positions in which they originally fell." and he gives as exceptions, accumulations in tin drifts and alluvial gravels. Under these circumstances therefore, the Port Campbell australites can be considered to have fallen on recent artificial structures, in which case, the evidence available may add some support to the possibility of the "Continuing Fall Theory" (4, p. 138) being correct.

On the other hand, there are no records of the discovery of australites in towns within the australite "strewn field." If australites are still falling, it is difficult to see why they should all be of similar composition, possess a limited variety of shapes unrepresented elsewhere in the world, and be confined in their distribution on the earth's surface, often in localized centres, to Southern Australia.

## Descriptions of Australites.

The colour, physical and optical properties of australites have been dealt with by many writers, and those of the Port Campbell forms do not differ in any marked degree from the descriptions already given.

The total weight of the 83 specimens is 194.056 grams, and the average specific gravity is 2.391.

The nomenclature used in this paper is similar to that employed by Dr. Fenner (3), except that the term "flow grooves" has been introduced to indicate deeper flow line structures, "bubble craters" to indicate surface cavities deeper and larger than bubble pits, and "flow pattern" to embrace flow lines and flow grooves. Letters and figures thus :—A1bi, refer to the classes and groups in the Fenner classification of the Shaw collection (3).

Class A—(Complete or nearly complete forms).

*Buttons.*—Seventeen specimens, average weight 3.143 grams, average specific gravity 2.397.

Specimen No. 63 is unique in having both surfaces equally honeycombed with bubble pits, and no flow lines or flow ridges.

In Nos. 5, 65, 74, 78, and 79, flow ridges are anti-clockwise, in No. 80 clockwise, and in the remainder, one to three concentric flow ridges occur on the anterior surface. In some cases, the ridges become crinkly towards the equators of the forms. Flow lines may be radial or crinkly on either posterior or anterior surfaces. Smooth equatorial bands indicate the position from which the flanges have flaked away from the body. No. 65 possesses a bubble crater 4 mm. across, and in No. 80, a pustule

contained in a bubble crater itself has a small bubble pit. Bubble pits are most common on the posterior surfaces, and they may be circular or elongated.

| No. on Map. | University Collection No. | Fenner Classification. | Diameter in mm. | Depth in mm. | Width of Flange in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|---|
| 63 | 3007 | A1a | 20 | 8·5 | 3·5 | 3·547 | 2·396 |
| 79 | 2981 | ,, | 20·5 | 8·5 | 3 | 3·667 | 2·401 |
| 78 | 2980 | ,, | 22 | 10 | 3·5 | 5·368 | 2·408 |
| 1 | 2730 | A1bi | 23 | 9 | 5 | 4·670 | 2·426 |
| 19 | 2943 | ,, | 21 | 12 | 3 | 5·023 | 2·411 |
| 18 | 2942 | A1bii | 24 | 11 | 4 | 5·432 | 2·401 |
| 95 | 3003 | ,, | 16·5 | 8·5 | 4 | 2·010 | 2·412 |
| 66 | 3005 | A1biii | 20 | 10 | 4 | 4·303 | 2·395 |
| 46 | 2990 | A1biiia | 14 | 8 | .. | 1·886 | 2·402 |
| 65 | 3004 | ,, | 15·5 | 9·5 | .. | 2·437 | 2·361 |
| 74 | 2974 | ,, | 16 | 10·5 | .. | 3·264 | 2·405 |
| 80 | 2986 | ,, | 15 | 9·5 | .. | 2·406 | 2·382 |
| 5 | 2929 | A1biiib | 14 | 7 | .. | 1·275 | 2·361 |
| 29 | 2953 | ,, | 11·5 | 7 | .. | 1·375 | 2·412 |
| 72 | 2973 | ,, | 11·5 | 8 | 5 | 1·998 | 2·416 |
| 11 | 2935 | A1biiic | 9 | 6 | .. | 0·733 | 2·379 |
| 24 | 2948 | A1f | 19 | 11 | .. | 4·045 | 2·385 |

Total weight = 53·429 gms.

*Lenses.*—Six specimens, average weight 1.072 grams, average specific gravity 2.387.

In Nos. 52 and 85 the rim is well defined, suggesting the development of a new flange. Flow ridges are anti-clockwise in No. 30. clockwise in No. 52, and concentric in Nos. 4, 13, and 85. The number of flow ridges is never more than two, and often only one. Flow lines are sometimes radial. Bubble craters and shallow "saw-marks" are rare. Bubble pits, mainly on the posterior surface, may be circular, oval or elongated, and on the honeycombed posterior surface, smooth areas often appear which possess a complicated flow line design.

Specimen No. 93 is a flat disc which Dr. Fenner suggests should be classed amongst the lenses on account of its probable genetic relationship to lens forms. Sub-class A2f of Fenner's classification constitutes the "pitted discs" which are considered to have been derived from lens-shaped australites by erosion and abrasion. The posterior surface of No. 93 possesses twelve bubble craters, but the form would not fall into the class A2f since it is extremely fresh, with entire and original surfaces, so it is placed in a special group A2i. The form is smaller than the discoidal australite described by Professor Skeats (6, p. 365). but Fenner records a still smaller type (3, p. 69) from the Shaw collection, which weighs only 0.15 grams. Still smaller forms in the Melbourne University collection, from Mr. S. F. C. Cook of Kalgoorlie, weigh respectively 0.104, 0.105, 0.118, 0.129, and 0.145 grams. All of these, however, have suffered a certain amount of abrasion.

| No. on Map. | University Collection No. | Fenner Classification. | Diameter in mm. | Depth in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|
| 52 | 2999 | A2a | 14·5 | 8 | 1·782 | 2·366 |
| 4 | 2928 | A2b | 12 | 6 | 1·026 | 2·353 |
| 30 | 2954 | ,, | 13 | 6·5 | 1·404 | 2·441 |
| 85 | 3014 | ,, | 13 | 7 | 1·377 | 2·378 |
| 13 | 2937 | A2c | 10 | 6 | 0·642 | 2·422 |
| 93 | 3000 | A2i | 9 | 1·5 | 0·200 | 2·345 |

Total weight = 6·431 gms.

*Ovals.*—Five specimens, average weight 3.338 grams, average specific gravity 2.403.

One form in this group was too large to be accommodated in A3b of Fenner's classification, so it has been necessary to constitute the following groups:—

A3bi—long axis over 21 mm.

A3bii—long axis 18 to 21 mm.

In Nos. 57 and 51 small remnants of flanges remain. Flow ridges are clockwise in No. 77, anti-clockwise in No. 71, and irregular in the other forms. In No. 51, flow grooves occur on the anterior surface, and around the sides of the form, depressions and ridges have been formed by flaking. In No. 57, a large flow lined area surrounded by bubble pits occurs on the posterior surface.

| No. on Map. | University Collection No. | Fenner Classification. | Length in mm. | Breadth in mm. | Depth in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|---|
| 57 | 2987 | A3bi | 24 | 18 | 11 | 6·516 | 2·439 |
| 51 | 2994 | A3bii | 19 | 14·5 | 13 | 5·038 | 2·401 |
| 77 | 2975 | A3c | 16 | 13·5 | 9 | 2·533 | 2·395 |
| 25 | 2949 | A3d | 14 | 11 | 6 | 1·330 | 2·418 |
| 71 | 2976 | ,, | 13 | 11 | 6·5 | 1·274 | 2·364 |

Total weight = 16·691 gms.

*Boats.*—Ten specimens, average weight 6.795 grams, average specific gravity 2.397.

In sub-class A4a, it has been necessary to provide three groups in order to accommodate forms having larger dimensions than those given by Fenner:—

A4ai—long axis over 40 mm.

A4aii—long axis 30 to 40 mm.

A4aiii—long axis 20 to 30 mm.

No. 76 is the largest form in this collection, and it possesses markings somewhat similar to those present on Billitonites, which often extend across the equator of the form from the anterior to the posterior surface, where they appear as circular pits. Flow

ridges are concentric in Nos. 68, 69, 83, 86, and 22, anti-clockwise in No. 82. Flow lines are simple, elliptical, dumb-bell shaped, and rarely concentric. In No. 2, a "saw-cut" on the anterior surface passes across the equator, and becomes lateral near the edges of the posterior surface, whilst a "saw-cut" in No. 68 appears to be the continuation of a fracture face. Bubble craters in Nos. 82, 83, and 86, sometimes contain smaller pits or pustules. Bubble pits are numerous on posterior surfaces. No. 12 approaches the canoe forms in shape, but is too broad and insufficiently pointed at the ends to be classified with them.

| No. on Map. | University Collection No. | Fenner Classification. | Length in mm. | Breadth in mm. | Depth in mm. | Width of Flange in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|---|---|
| 76 | 2970 | A4ai | 46 | 22 | 18 | .. | 29·480 | 2·452 |
| 68 | 2971 | A4aii | 40 (orig.) | 21 | 10 | 3 | 4·401 | 2·379 |
| 69 | 2972 | ,, | 34 (orig.) | 18·5 | 9 | 3·5 | 3·831 | 2·396 |
| 81 | 2982 | ,, | 32 | 21 | 14 | .. | 12·815 | 2·394 |
| 2 | 2926 | A4aiii | 28 | 14 | 9 | .. | 4·271 | 2·384 |
| 82 | 2983 | ,, | 28 | 15 | 7·5 | 2 | 3·715 | 2·427 |
| 83 | 2985 | ,, | 22 | 14 | 7·5 | .. | 2·886 | 2·385 |
| 86 | 3013 | ,, | 23 | 17 | 8·5 | 3 | 3·428 | 2·373 |
| 22 | 2946 | A4b | 21 | 11·5 | 7 | .. | 2·145 | 2·396 |
| 12 | 2936 | A4c | 17 | 10 | 4·5 | .. | 0·981 | 2·386 |

Total weight = 67·953 gms.

*Canoes.*—Two specimens, average weight 1.019 grams, average specific gravity 2.373:

No. 21 is "pen-nib" shaped, one end of the canoe being incomplete. Flow lines and elongated pits are parallel to the shape of the form. No. 20 is not a true canoe, but is narrower and more pointed at the ends than boat forms.

| No. on Map. | University Collection No. | Fenner Classification. | Length in mm. | Breadth in mm. | Depth in mm. | Width of Flange in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|---|---|
| 21 | 2945 | A5a | 35–40 (orig.) | 9 | 4 | 2–3 | 1·313 | 2·375 |
| 20 | 2944 | A5c | 17 | 8 | 4 | .. | 0·726 | 2·372 |

Total weight = 2·039 gms.

*Dumb-bells.*—Three specimens, average weight 2.499 grams, average specific gravity 2.392.

No. 67 is not dumb-bell shaped in all aspects, the anterior surface possessing a strong central ridge and a bubble crater 8 mm. x 10 mm. at one end. The ends tend to be pointed. Bubble pits are rare, and flow lines follow the shape of the forms, being more conspicuous on flange remnants which are confined to the waists.

| No. on Map. | University Collection No. | Fenner Classification. | Length in mm. | Width of Waist in mm. | Width of Ends in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|---|
| 9 | 2933 | A6a | 30 | 8 | 10 | 2·435 | 2.387 |
| 67 | 3006 | ,, | 30 | 8 | 9·5 | 3·722 | 2·437 |
| 3 | 2927 | A6d | 18 | 6·5 | 9 | 1·339 | 2·353 |
| | | | Total weight = 7·496 gms. | | | | |

*Teardrop.*—One specimen, weight 3.066 grams, specific gravity 2.401.

No. 70 (2979). A7a. 20 mm. long, maximum depth 9 mm., width 13 mm. at the larger end, 6 mm. at the other end. Flange is 3 mm. wide extending from the narrow end half way along each side. Flow lines are parallel to the long axis.

Class B—(Fragments of forms listed in Class A).

*Button Fragments.*—Nineteen specimens, average weight 0.989 grams, average specific gravity 2.391.

The surface features of these fragments are similar to those exhibited by complete forms, but fracture faces display various flow patterns which cannot be observed in complete australites. No. 53 is a case where a button has fractured clean in half, the fracture surface exhibiting a bubble crater 7 mm. across coalesced with a smaller crater, and having an outlet on to the anterior surface. No. 55 is a portion of the other half of No. 53 showing the opposite sides of the bubble craters. No. 17 shows an internal string of bubbles arranged in crescent fashion. No. 48 is a flaked core.

| No. on Map. | University Collection No. | Fenner Classification. | Width of Flange in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|
| 27 | 2951 | B1c | 3 | 1·054 | 2·406 |
| 28 | 2952 | ,, | 4 | 1·717 | 2·388 |
| 60 | 3010 | B1d | 4 | 1·498 | 2·416 |
| 48 | 2991 | B1f | .. | 4·226 | 2·432 |
| 53 | 2995 | B1i | 3·5 | 3·440 | 2·389 |
| 55 | 2996 | ,, | .. | 0·781 | 2·381 |
| 50 | 2993 | B1j | 4·5 | 1·697 | 2·358 |
| 58 | 2989 | ,, | 4 | 2·160 | 2·381 |
| 88 | 3016 | ,, | 4 | 1·950 | 2·422 |
| 94 | 3002 | ,, | 4·5 | 3·263 | 2·380 |
| 17 | 2941 | B1k | .. | 0·433 | 2·368 |
| 54 | 2997 | ,, | 3·5 | 1·181 | 2·440 |
| 84 | 2984 | ,, | 4 | 0·835 | 2·406 |
| 91 | 3018 | ,, | 2·5 | 0·783 | 2·417 |
| 47 | 2992 | B1l | .. | 0·863 | 2·397 |
| 56 | 2998 | ,, | .. | 0·356 | 2·438 |
| 62 | 3012 | ,, | .. | 0·572 | 2·423 |
| 87 | 3017 | ,, | .. | 0·813 | 2·391 |
| 90 | 3019 | ,, | .. | 0·450 | 2·356 |
| | | | Total weight = 26·788 gms. | | |

*Flange Fragments.*—Twelve specimens, average weight 0.405 grams, average specific gravity 2.372.

The average width of these flange fragments is 4 mm., and attachment bands, indicating where the flanges have flaked from australites, are generally about 2.5 mm. wide.

In the Shaw collection, flange fragments were classified with nondescript fragments (3). The Port Campbell examples are included in a special group B1m, because they all appear to have been derived from round forms. Group B1m is divided into:—

B1mi—flange fragments with small portions of attached body.

B1mii—flange fragments with no trace of body.

Detached flange fragments generally have almost perfectly smooth posterior surfaces, and crinkly flow ridges on the anterior surfaces. Most of the flanges, where fractured, display complex and variable flow patterns. E. J. Dunn has figured excellent examples of such structures (2, plate 15).

| No. on Map. | University Collection No. | Classification. | Width. | Weight. | S.G. |
|---|---|---|---|---|---|
| 15 | 2939 | B1mi | 6 | 0·399 | 2·418 |
| 31 | 2955 | ,, | 5 | 0·265 | 2·409 |
| 75 | 2978 | ,, | 4·5 | 0·413 | 2·387 |
| 7 | 2931 | B1mii | 4 | 0·226 | 2·239 |
| 8 | 2932 | ,, | 4 | 0·529 | 2·340 |
| 14 | 2938 | ,, | 3 | 0·335 | 2·393 |
| 23 | 2947 | ,, | 3·5 | 0·242 | 2·372 |
| 32 | 2956 | ,, | 4 | 0·332 | 2·423 |
| 33 | 2957 | ,, | 4·5 | 0·275 | 2·330 |
| 59 | 3011 | ,, | 5 | 0·587 | 2·396 |
| 61 | 3009 | ,, | 3·5 | 0·454 | 2·377 |
| 73 | 2977 | ,, | 5 | 0·599 | 2·377 |
| Total weight = 4·864 gms. | | | | | |

*Disc Fragment.*—Weight 0.209 grams, specific gravity 2.322.

A disc fragment is included in a special group B1n. Originally plate or disc shaped, it shows two small "saw cuts" on the posterior surface, and eight concentric flow ridges with numerous flow lines parallel to them. The thickness at the equator of the lip is 2 mm. and 1 mm. elsewhere.

*Boat Fragments.*—Three specimens, average weight 0.967 grams, average specific gravity 2.399.

Dr. Fenner has divided group B2f into:—B2fi—larger fragments, and B2fii—smaller fragments. As employed in this paper, B2fi refers to one-half or over, and B2fii to less than one-half of boat forms.

| No. on Map. | University Collection No. | Classification. | Width in mm. | Depth in mm. | Weight in gms. | S.G. |
|---|---|---|---|---|---|---|
| 64 | 3008 | B2fi | 13 | 7 | 1·397 | 2·408 |
| 26 | 2950 | B2fii | 13 | 10 | 0·709 | 2·411 |
| 89 | 3015 | ,, | 14·5 | 9 | 0·811 | 2·378 |
| Total weight = 1·197 gms. | | | | | | |

*Dumb-bell Fragment.*—Weight 1.538 grams, specific gravity 2.418.

No. 10 (2934). B2gi. One-half of a form which may have been "ladle-shaped." In one aspect it is similar to the "air

bomb" figured by Fenner (3, plate viii., Fig. 8). Crinkly flow ridges occur on both surfaces.

*Nondescript Fragments.*—Three specimens, average weight 0.281 grams, average specific gravity 2.369.

Bubble cavities are developed over the irregular surfaces of No. 49, and the other two fragments show intricate flow patterns.

| No. on Map. | University Collection No. | Fenner Classification. | Weight. | S.G. |
|---|---|---|---|---|
| 16 | 2940 | B3a | 0·132 | 2·316 |
| 49 | 2988 | ,, | 0·411 | 2·403 |
| 92 | 3001 | ,, | 0·301 | 2·388 |
| Total weight = 0·844 gms. | | | | |

## Internal Structures.

In the accompanying sketch, some of the flow patterns observed on the fractured surfaces of australites are diagrammatically represented.

FIGS. 1-7.—Internal Structures of Australites. Fracture surfaces of various forms of australites showing flow patterns.

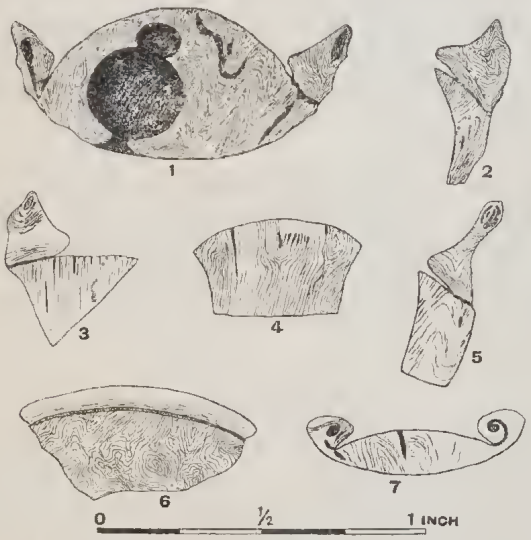



FIG. 1.—Button with flange showing large bubble cavities, flow lines and flow grooves. (2995). Fig. 2.—Button fragment showing flow lines passing into flow grooves. (2984). Fig. 3.—Button fragment showing vertical flow lines and flow grooves opening into bubble pits on the posterior surface. (3016). Fig. 4.—Boat fragment with complex flow lines and flow grooves. (3015). Fig. 5.—Button and flange fragment with elliptical flow grooves near the tip of the flange. (2951). Fig. 6.—Button fragment with flange showing small concentric flow lines, and complex flow line pattern within the body. (3002). Fig. 7.—Narrow end of teardrop with the flange showing spiral and circular flow grooves. (2979).

Bubbles are not common, a few are shown in Figs. 2 and 3. They are generally minute.

Bubble cavities are rare. A large one is illustrated in Fig. 1. It is 7 mm. across, and both it and the smaller cavity possess very smooth walls with fine flow lines.

Flange junctions can be well studied in fractured specimens. The contact with the body of the australite is often very narrow, and the line of junction is sometimes continued into the flange as flow grooves or strings of bubbles.

Flow lines are shallow, narrow markings observed on almost all flaked surfaces. They may be simple and vertical (Fig. 3), circular, elliptical, or folded in a very complex manner (Fig. 6), and in some cases, open out into flow grooves towards the posterior surface (Figs. 3 and 4). These lines appear to represent slight variations in composition.

Flow grooves are relatively deep, sometimes irregular elongated cavities, bearing a distinct relationship to flow lines with which they are usually parallel and often continuous. The grooves may be circular, spiral, elliptical, sinuous, or crescent shaped (Figs. 1, 2, 5, and 7).

No two flaked surfaces of australites from the Port Campbell district possessed similar flow patterns, the structure lines exhibiting considerable diversity, especially in the case of the flanges.

## Composition.

The australites from this district have not been analysed, but Dr. Summers has quoted an analysis of an australite from Curdie's Inlet (7), which is situated only 14 miles to the west of this area. It is probable that the Port Campbell occurrences are similar in composition.

## Fragmentation.

Abrasion, insolation, bush fires, etc., are considered to be the agents causing australites to shed their flanges and develop flaked equatorial zones (3, p. 68). That is to say, fragmentation is regarded as occurring after the australites have been resting on the earth's surface for some time.

Dr. Fenner (3), in dealing with lens forms, states that "the lens may be developed from the normal flanged button, having lost its flange in the course of development, and just started to develop a new one." Such a phenomenon must have occurred during flight through the air, since flanges are considered to be secondary structures produced during passage through the atmosphere. The flanges would most likely reach the earth as separate entities (usually fragmented), and so provide evidence

of "flight fragmentation." The main body of an australite may also undergo flaking during flight, giving rise to sectors of the body attached to portions of flanges. Lines of weakness that might be responsible for such fragmentation could be caused by the presence of strings of bubbles, "saw-cuts," or large internal bubble cavities.

The various phenomena exhibited by the australites from Port Campbell do not appear to have developed from weathering, etc., for the specimens are very fresh in appearance. Some have been undoubtedly fractured at the earth's surface, for the fracture face is highly glassy, more so than pieces of bottle glass picked up from various spots in the district, so that such fractures appear to be recent and suggest impact with a hard surface.

Some button fragments show a collection of bubbles at the union of flange and body, the escape of such gas bubbles through the narrow junctions, might have weakened the lines of contact, and assisted the fragmentary shedding of flanges during flight.

The presence of gases enclosed in cavities in the interior of australites may also have had some influence on the fracturing of the form during flight. No. 53 is exactly one-half of a button, the other half must have shattered into many fragments, most likely during flight, for only one small portion (No. 55) of the shattered half could be found in the vicinity.

The "saw-cut" in No. 82, extends from the equator of the flange to half way within the body. If such saw-cuts are due, as they may be, to contraction near the completion of flight, the continuation of development of the saw-cut would eventually lead to the breaking up of the australite into two pieces, as is thought to have been the case with specimen No. 68.

Similarly, where small saw-cuts develop through flanges and pass into the body as incipient fracture lines along the junction of the two (as in No. 79), a line of weakness would develop along which the first section of the flange would break away, either free from attached body fragment, or carrying a section of the body with it.

Apart from specimens 53 and 55, none of the fragmentary forms found in the Port Campbell area could be assigned to any other fragments, and it is therefore likely that these broken objects fell independently of one another.

In classifying 1927 fragments from the Nullarbor Plains, Dr. Fenner states that no two parts belonged to the one australite, and he suggests that the specimens were probably fractured by grass or scrub fires passing over the country on which they lay. If such was the case, one would expect to find amongst such a large number of fragments, a few at least that fitted the forms undergoing fracturing.

The evidence set out above suggests that flaking and fragmentation of australites are not necessarily due to agents acting upon them at the earth's surface, and that fragmentation might reasonably have taken place during flight.

H. H. Nininger (5) describes flight markings on stony meteorites as deformations attributable to conflict with the atmosphere during flight. Similar phenomena in australites are most likely caused in the same way, by the carving action of the resisting air on bodies travelling at high velocities.

## Summary.

Eighty-three australites, complete and fragmentary, discovered in the Port Campbell district, have been described, and their positions marked on a map. They have been classified according to Dr. Fenner's arrangement of the W. H. C. Shaw collection, with the addition of groups where necessary.

Internal structures exhibited on the flaked surfaces of australites have been figured, and suggestions put forward regarding the possible fragmentation of australite bodies during flight.

The evidence of the age of australites in the Port Campbell district suggests that they are historically recent, although convincing proof to this end is not available.

## Acknowledgments.

Thanks are due to Dr. Fenner for supplying many valuable suggestions. Miss M. K. Chisholm collected and presented specimens 11, 15, 21, 26, and 29, and R. E. Jacobson, M.Sc., discovered Nos. 47, 49, 57, 58, 60, 61, 65, 66, 85, and 92-4.

## Addendum.

Since the foregoing was written, 52 additional australites have been found by the author in the Sherbrook River district, seven months after the discoveries described in this paper. Of this number, 29 were found on the surface of areas which had previously been thoroughly searched, and 23 on the surface of places which, hitherto, had received but slight attention. One specimen in particular, a perfect australite button, has an exceedingly new and fresh appearance.

## References.

1. Beyer, H. Otley. Philippine Tektites. *Philippine Mag.*, xxxii., No. 11 (331), 1935.

2. Dunn, E. J. *Bull. Geol. Surv. Vic.*, ii., Pt. 4, pp. 202-207, 1908.

3. Fenner, C. Australites, Part I. Classification of the W. H. C. Shaw Collection. *Trans. Roy. Soc. Sth. Aust.,* lviii., pp. 62-79, 1934.

4. ———. Australites, Part II. Numbers, Forms, Distribution, and Origin. *Trans. Roy. Soc. Sth. Aust.,* lix., pp. 125-140, 1934.

5. Nininger, H. H. Further Studies in the Surface Features of Meteorites. *Am. Journ. Sci.,* xxxii., No. 187, pp. 1-20, 1936.

6. Skeats, E. W. Descriptions of Three Unusual Forms of Australites from Western Victoria. *Proc. Roy. Soc. Vic.,* xxvii. (n.s.), (2), pp. 362-366, 1915.

7. Summers, H. S. On the Composition and Origin of Australites. *Aust. Assoc. Adv. Sci.,* xiv., pp. 189-199, 1913.